



IMPORTANT INFORMATION

Diesel is a convenient, efficient and cost effective form of energy. Today, we supply diesel fuels to a wide variety of customers ranging from motorists, through farmers, fishermen and road transport operators, to the large industrial user-using diesel to fire boilers. Shell is committed to supplying all customers with fuel of the highest quality.

Once delivered, however, even the highest quality diesel can be degraded if a few simple housekeeping procedures are not followed.

Poor housekeeping can result in deterioration of stored fuel to such an extent that, if left unchecked, breakdown of vehicles and machinery can follow. A contributing cause of this phenomenon is microbes; minute living creatures that can thrive in a poorly maintained tank but which will not flourish if the proper conditions are maintained. The essence of good housekeeping is avoiding accumulation of water and dirt in fuel tanks. Sounds simple enough? Indeed, there is no mystery involved once the key facts are known - you certainly do not need to know anything about biology to keep your fuel free from bugs!

Most customers never come across this problem, but even the few that do could probably avoid it. This pamphlet is designed to give you the facts and dispel some of the myths surrounding this subject - to help make sure your fuel is always fit for purpose.

For further information contact the Shell Technical Helpline:

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Protecting your fuel

Some key facts about microbial contamination of diesel (commonly known as "diesel bug")



SOME KEY FACTS ABOUT MICROBIAL CONTAMINATION OF DIESEL (COMMONLY KNOWN AS “DIESEL BUG”)

Can organisms actually grow in fuels?

Particular forms of micro-organism can grow in fuels but only in certain conditions. Three groups of microbes have been found to contaminate fuels: bacteria, filamentous fungi (and their spores) and yeasts. The most important criterion for microbial growth to occur is that water must be present - in fact the microbes live and grow in the water, either the separate layer in the bottom of the tank or in droplets suspended in the fuel, or as biofilm. Biofilms are colonies of microbes that are attached to the surface of a tank. The microbes actually live in the fuel/water interface drawing their nutrients from the fuel.

The spores of microbes can survive for years in dry fuels germinating when conditions are favourable for growth i.e. when water is present.

To prevent micro-organisms growing good housekeeping is essential - this means regular monitoring, draining and cleaning of fuel storage and vehicle running tanks.

A systematic approach to preventative maintenance should be adopted.

What happens if diesel is contaminated with microbes?

When the number of microbes present in the fuel exceeds certain limits, blockage of fuel filters will occur. The blockage may also be associated with slimes and sludges produced by microbial activity and the mats of fungal growth that occur at the fuel/water interface.

In some cases, notably where sulphate-reducing bacteria are present, microbial contamination can lead to corrosion of storage tanks and pipe-work.

Contamination can also increase the entrainment of water in the diesel, as metabolic by-products from the microbes tend to stabilise the water in the diesel.

When diesel is contaminated with sufficiently high levels of microbes then significant problems can occur. Because of the high impact and mysterious nature, microbial contamination tends to get a lot of publicity, making it seem quite common, but in fact this is quite rare.

Which fuels can be contaminated?

Basically the group of fuels we call “middle distillates” are the most susceptible. This group includes diesel, gas oils, marine distillates, heating oils and kerosines. Some groups of customers, especially those working in the marine environment, are more susceptible, but problems have occurred in farm vehicles and fleets of trucks and buses. Although Aviation Turbine Fuel (Jet fuel) is also susceptible, the number of reported problems is less than with other middle distillates. This is due to the particularly stringent housekeeping procedures, as well as extensive filtration processes used in the aviation industry. Microbes can also affect petrol, but infections to petrol are not as common as for diesel. It is believed that petrol exerts a toxic effect on microbes.

To an extent the actual incidence of problems depends on how and where the fuel is used, because some equipment with relatively coarse filters can tolerate a much higher microbe content than others.

Where do the micro-organisms come from?

Microbes are everywhere! Those that can survive in fuels are present naturally in the soil and are carried by the air, entering the fuel during storage and handling. But they will remain dormant if no water is present in contact with the fuel.

Are they present in the fuel when it is delivered?

Fuels produced in the refinery (where the high process temperatures will kill microbes) are initially sterile. By applying suitable housekeeping procedures in our operations we can generally ensure that the number of microbes in the fuel is maintained at a level where they do not cause problems. But no fuel can ever be guaranteed to be completely free of microbes, because as we have already said, microbes are always present in the environment and are carried in the air. The important point is to ensure that they remain “dormant” so that the number of microbes in the fuel can be maintained at a level where they do not cause problems. Microbes cannot grow in the absence of water - good housekeeping will address this issue.

Some customers have noticed problems directly after taking a fresh batch of fuel and naturally question the quality. However the cause of the problem is that microbes (or other tank sludges), that are already present in the bottom water layer, below the level of the tank off-take, are stirred when the delivery is made and distributed throughout the new fuel. Proper draining procedures should eliminate this.

What are the symptoms, how do I know if I have a problem?

If a problem is suspected the first step is to take samples for visual inspection. These should be taken from tank top, middle and bottom of the tank, and if possible the tank drain valve. The samples should be clear and bright and free

from visible sediment. However, a dirty or hazy fuel does not automatically mean that microbes are to blame. Conversely a fuel that looks clean to the eye can have a considerable microbe content.

The microbes are very small, typically from about 0.001- 0.005 mm in diameter so you cannot see individual organisms without a high power microscope. However, if they are left unchecked you may find that a fibrous mat has grown at the fuel-water interface. More typically as the amount of microbes increases a hazy product can be seen and would get darker in colour with time.

The most common problem associated with microbes is blocked or partially blocked filters causing vehicles or plant to stop running or run at low power. On inspection the filters are usually black and slimy - though again this is not sufficient to prove that microbes are the root cause.

In certain (fortunately rare) cases, microbes such as sulphate reducing bacteria can cause corrosion of tank material but this can probably only be detected by inspection of the tank. This problem usually only occurs after many weeks or months of poor housekeeping.

Microbial contamination can be properly confirmed only by application of specialised tests.

What can be done if contamination is detected?

This depends on the severity of the contamination. If contamination is not major, then the tank can be treated by settling and removal of the water and sludge at the tank bottom, and then filtration of the diesel fuel.

If the contamination is severe then it may be necessary to physically clean the tank out. The tank has to be completely drained and all contamination removed. This might involve high pressure washing of the tank walls or steam cleaning. In some cases a biocide might be necessary, but in general we would only suggest doing this after tank cleaning. Biocides are toxic and we would recommend that specialist contractors carry out such treatment.

It should be noted that simply killing the microbes, by treatment of the tank with biocide, is not a sufficient remedy, because the dead microbes, which will make up part of the biomass (total weight of microbes in the fuel) can still block filters. After treatment the sediment on the tank bottom should be removed.

Microbial mat at the fuel/water interface of contaminated diesel.



Fungal hyphae and other debris from the surface of a diesel fuel filter which blocked in service.



How do I avoid contamination?

The simple answer is to minimise the water content. Though microbes can survive in fuels without water they cannot multiply and therefore cannot cause any problems. The most important steps are to prevent any excess water getting into your tanks and drain off the water that does accumulate at the bottom. Clearly, tanks that let water in – perhaps rainwater through leaky seals or a poorly fitting filler plug - can and should be rectified. You cannot completely stop water from getting in, the breathing of your tanks and the changing humidity and temperature of the air make this impossible. However by regular draining you can minimise the risk of microbial growth.

It is important to note that tank water bottoms and sludges are hazardous waste and must be dealt with appropriately, and always in accordance with legislation.

How do I know if water is present?

The simplest approach is to drain from the lowest part of your tank into a clear container, allow the sample to settle and if water is present it should be visible. If you do find water, continue to drain until clear fuel appears and then close the valve. If this approach is not feasible, an alternative is to use a water finding paste on the end of a dipstick - if water is found it should be pumped out.

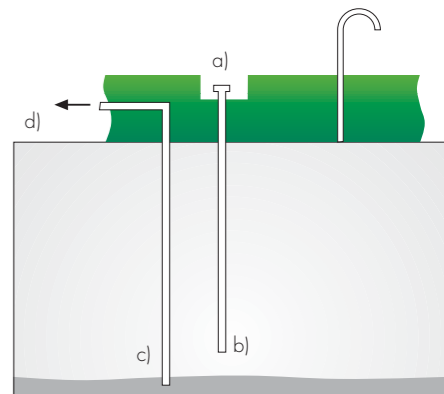
Tanks - the good and the bad

We have stressed the importance of good housekeeping in minimising the risk of microbial contamination. This means keeping the water out as far as possible and not letting it accumulate.

Storage facilities should be designed with this in mind, but some make this objective quite difficult. Using the example of underground tanks, we illustrate some features that make effective housekeeping difficult, and some modifications that can make life easier. The differences are simple and largely common sense, and the same principles apply to other types of tank. Of course all features of tank layout must be considered from the safety standpoint, as well as from their practicality.

Typical poorly designed installation

- Fill point below ground level.
- Drain point - which does not give access to the lowest point of the tank.
- Suction point close to the bottom of the tank.
- No manhole.



Some modifications to help combat microbes

- Raise fill point above ground level.
- Drain point at lowest point of the tank.
- Suction point clear of the water bottom.
- Add manhole access.
- Establish and maintain good housekeeping procedures.

